

“Detailed Description of the Invention”. Applicants respectfully request that the Examiner withdraw this objection.

Applicants have amended the title to render it clearly indicative of the invention to which the claims are directed. Applicants respectfully request that the Examiner withdraw this objection.

Applicants have corrected any errors of which they have become aware. Applicants have removed the whole of the section REFERENCE NUMERALS IN DRAWING on pages 18, 19 and 20. Applicants respectfully request that the Examiner withdraw this objection.

Applicants are amending claim 18, to better describe the claimed invention. Applicants respectfully request allowance of this claim.

No new matter is added by these amendments and they are fully supported by the specification. Applicants respectfully request entry of these amendments. Further, Applicants respectfully request that the Examiner reconsider the above-captioned patent application in view of the foregoing amendments and the following remarks.

#### REMARKS

##### **1. Objections and Rejections**

The Office Action objects to claims 18, 21 and 22 as containing subject matter that was not described in the specification (35 USC 112), and because the disclosed invention lacks utility (35 USC 101). Claims 1, 2, 4, 7, 23, and 24 stand rejected under 35 USC 102(b); claims 1, 2, 8-16, 23, 24, 27 and 28 stand rejected under 35 USC 102(e); claims 3, 5, 17, 25, 26, 29-37 stand rejected under 35 USC103(a).

##### **2. 35 USC 112**

Claim 18 contains the phrase “means for causing the oscillation of said manipulating means”, which draws on the language used on page 31, line 18: “the active control elements may be pulsed”. The term “AC power” on page 31 line 19 is commonly taken to be proportional to the voltage generated and the current flowing in an external circuit. The claimed invention is intended to be utilized in association with an external circuit for the generation of electrical power. Applicants have amended claim 18 to make it dependent on claim 7, and alternating

voltage has been used instead of alternating current. Applicants have cancelled claims 20 and 21. Applicants respectfully request that the Examiner withdraw this objection.

### **3. 35 USC 101**

Applicants have amended claim 18 to overcome the objection to the generation of an alternating current. Applicants have enclosed, with this Amendment, a copy of the article by Hishinuma *et al*, entitled *Refrigeration by combined tunneling and thermionic emission in vacuum: Use of nanometer scale design*, Applied Physics Letters, Volume 78, Number 17, pp 2572-2574, 2001, from which we now quote:

Our calculations show that the barrier height which electrons must overcome to escape into vacuum can be lowered significantly by reducing the emitter and collector gap to around 10-100 nm. The narrow gap and strong electric field also make it possible for electrons to tunnel to the collector. This is detrimental for cooling when electrons originating below the Fermi level, as is the usual case of Nottingham heating. However, the calculations presented here show that there is a range of gap and bias voltage in which tunneling electrons originating from above the Fermi level are dominant.

Thus, the disclosed invention is not inoperative and therefore does not lack utility. Applicants respectfully request that the Examiner withdraw this objection.

### **4. 35 USC 102**

#### **Examiner rejects claims 1-2 and 7 as being anticipated by Kennel (US5410166).**

Kennel teaches (Col 3 ln14) that his invention is concerned with the “cold cathode generation of free electrons”.

In Applicants’ invention, the process controlling the movement of electrons from the emitter or cathode to the collector or anode is a quantum mechanical one: the electrons tunnel from the emitter to the collector and do not appear as free electrons in the gap between the electrodes.

Kennel’s invention does not teach that “a collector electrode, positioned sufficiently close to said emitter electrode for electrons to tunnel from the emitter electrode to the collector electrode” (see claim 1c of the present invention), and does not contemplate the use of an energy source for promoting said tunneling (see claim 1a of the present invention).

Kennel does therefore not anticipate the present invention. Applicants respectfully request that the Examiner withdraw this objection.

**Examiner rejects claims 1, 2, 4, 7, 23 and 24 as being anticipated by Hatsopoulos and Gyftopoulos.**

Again, the device of Hatsopoulos and Gyftopoulos (H&G) does not contemplate tunneling between the electrodes, and whilst there is provided a means for manual adjustment of the electrode spacing, there is no teaching that the electrodes could or should be spaced at a distance that will allow quantum mechanical tunneling (claims 1, 2, 4, 7). In addition H&G does not teach electrodes comprising matched topological features as taught in claims 23 and 24 of the present invention.

H&G does therefore not anticipate the present invention. Applicants respectfully request that the Examiner withdraw this objection.

**Examiner rejects claims 1, 2, 8-16, 23, 24 and 27 as being anticipated by DiMateo (US6084173)**

The device of DiMateo does not contemplate “electron tunneling”, but rather teaches that the generation of carriers in a semiconductor surface is enhanced by the close proximity of a heated surface (emitter or radiator). This enhancement is caused by radiationless transfer of energy from the heated surface to the semiconductor surface, and does not involve the emission of electrons.

DiMateo does therefore not anticipate the present invention. Applicants respectfully request that the Examiner withdraw this objection.

**Examiner rejects claims 23 and 28 as being anticipated by Rason (US3843896)**

The electrodes in the device of Rason do not comprise matching topological features as described in the present invention. At col 16 ln 2, Rason states that “both emitter and collector surfaces **86** and **94** are preferably identical Ta-O-Cs surfaces to prevent components of the emitter from poisoning the collector.” Thus, while the materials in Rason are the same, Rason

does not teach that "surfaces have topographically matching features." Applicants respectfully request that the Examiner withdraw this objection.

### **5. 35 USC 103**

**Examiner rejects claim 3 in view of Hatsopoulos and Gyftopoulos, Kennel or DiMatteo in further view of Rason.**

**Examiner rejects claim 5 in view of Hatsopoulos and Gyftopoulos, Kennel or DiMatteo in further view of Yasuda (US5487790).**

**Examiner rejects claim 17 in view of DiMatteo in further view of Cox (US6064137).**

H&G, Kennel and DiMatteo fail to disclose electron tunneling as disclosed in claim 1. Claims 3, 5 and 17 are dependent on claim 1. Therefore, H&G, Kennel or DiMatteo in view of Rason, Yasuda or Cox fail to teach or suggest all of the claim limitations of claims 3, 5 and 17. Accordingly, a *prima facie* case of obviousness has not been made. Applicants respectfully request that the Examiner withdraw this objection.

**Examiner rejects claims 25 and 26 in view of Hatsopoulos and Gyftopoulos, and DiMatteo.**

As stated by the Examiner, H&G and DiMatteo fail to teach or suggest the collector and emitter positioned within 200 or 100 angstroms. No evidence is cited why it would have been obvious to a person skilled in the art at the time of the invention to construct the diode of DiMatteo or H&G with the electrode spacing of 200 or 100 angstroms to provide a small air gap to reduce thermionic leakage around the collector. Accordingly, a *prima facie* case of obviousness has not been made. Applicants respectfully request that the Examiner withdraw this objection.

Examiner rejects claims 29 – 32 in view of Rason, in view of Richards (US4281280) and Edelson (US5874039).

Examiner rejects claims 33, 35 in view of Rason, and Cox (US6064137).

Examiner rejects claim 34 in view of Rason, and Cox (US6064137).

Examiner rejects claim 36 in view of Rason, and Cox (US6064137) and DiMatteo.

Rason, Richards, Edelson, Cox and DiMatteo fail to disclose matching topological features as disclosed in claim 23. Claims 29 - 36 are dependent from claim 23. Therefore, Rason in view of Richards, Edelson, Cox or DiMatteo fail to teach or suggest all of the claim limitations of claims 29 - 36. Accordingly, a *prima facie* case of obviousness has not been made. Applicants respectfully request that the Examiner withdraw this objection.

Examiner rejects claim 37 in view of Rason, and Cox (US6064137) and DiMatteo.

As stated by the Examiner, Rason, Cox nor DiMatteo teach or suggest piezoelectric positioning the electrodes within 1 and 100 angstroms. No evidence is cited why it would have been obvious to a person skilled in the art at the time of the invention to construct the diode of Rason and Cox with piezoelectric positioning the electrodes within 1 and 100 angstroms. Accordingly, a *prima facie* case of obviousness has not been made. Applicants respectfully request that the Examiner withdraw this objection.

#### CONCLUSION

Applicants respectfully submits that this application, as amended, is in condition for allowance, and such disposition is earnestly solicited. If the Examiner believes that discussing the application with one of the Applicants over the telephone might advance prosecution, Applicants would welcome the opportunity to do so.

Respectfully submitted,



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